01-15-04

#AF 3722

Practitioner's Docket No. 1515.3001.001 ***PATENT***

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: William R. Voigt
Application No.: 09 /766,025 Group No.:
Filed: January 19, 2001 Examiner: Brian D. Walsh
For: HELICAL ROTARY CUTTER AND METHOD

Commissioner for Patents
Washington, D.C. 20231

TRANSMITTAL OF APPEAL BRIEF (PATENT APPLICATION—37 C.F.R. § 1.192)

NOTE: The phrase "the date on which" an "appeal was taken" in 35 U.S.C. 154(b)(1)(A)(ii) (which provides an adjustment of patent term if there is a delay on the part of the Office to respond within 4 months after an "appeal was taken") means the date on which an appeal brief under § 1.192 (and not a notice of appeal) was filed. Compliance with § 1.192 requires that: 1. the appeal brief fee (§ 1.17(c)) be paid (§ 1.192(a)); and 2.the appeal brief complies with § 1.192(c)(1) through (c)(9). See Notice of September 18, 2000, 65 Fed. Reg. 56366, 56385-56387 (Comment 38).

1. Transmitted herewith, in triplicate, is the APPEAL BRIEF in this application, with respect to the Notice of Appeal filed on 12-14-03.

NOTE: "Appellant must, within two months from the date of the notice of appeal under § 1.191 or within the time allowed for reply to the action from which the appeal was taken, if such time is later, file a brief in triplicate. . . " 37 C.F.R. § 1.192(a) (emphasis added).

CERTIFICATION UNDER 37 C.F.R. §§ 1.8(a) and 1.10*
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37 C.F.R. § 1.8(a)

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37 C.F.R. § 1.10 *

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TRANSMISSION

☐ facsimile transmitted to the Patent and Trademark Office, (703) ____________

Bambi L. Straebel
Signature

Date: 1-14-04

Bambi L. Straebel
(type or print name of person certifying)

** Only the date of filing (§ 1.6) will be the date used in a patent term adjustment calculation, although the date on any certificate of mailing or transmission under § 1.8 continues to be taken into account in determining timeliness. See § 1.703(f). Consider "Express Mail Post Office to Addressee" (§ 1.10) or facsimile transmission (§ 1.6(d)) for the reply to be accorded the earliest possible filing date for patent term adjustment calculations.*

2. STATUS OF APPLICANT

This application is on behalf of

☐ other than a small entity.

☒ a small entity.

A statement:

☐ is attached.

☒ was already filed.

3. FEE FOR FILING APPEAL BRIEF

Pursuant to 37 C.F.R. § 1.17(c), the fee for filing the Appeal Brief is:

☒	small entity	$160.00
☐	other than a small entity	$320.00

Appeal Brief fee due $ 160.00

4. EXTENSION OF TERM

NOTE: 37 C.F.R. § 1.704(b) ". . .an applicant shall be deemed to have failed to engage in reasonable efforts to conclude processing or examination of an application for the cumulative total of any periods of time in excess of three months that are taken to reply to any notice or action by the Office making any rejection, objection, argument, or other request, measuring such three-month period from the date the notice or action was mailed or given to the applicant, in which case the period of adjustment set forth in § 1.703 shall be reduced by the number of days, if any, beginning on the day after the date that is three months after the date of mailing or transmission of the Office communication notifying the applicant of the rejection, objection, argument, or other request and ending on the date the reply was filed. The period, or shortened statutory period, for reply that is set in the Office action or notice has no effect on the three-month period set forth in this paragraph."

NOTE: The time periods set forth in 37 C.F.R. § 1.192(a) are subject to the provision of § 1.136 for patent applications. 37 C.F.R. § 1.191(d). See also Notice of November 5, 1985 (1060 O.G. 27).

NOTE: As the two-month period set in § 1.192(a) for filing an appeal brief is not subject to the six-month maximum period specified in 35 U.S.C. § 133, the period for filing an appeal brief may be extended up to seven months. 62 Fed. Reg. 53,131, at 53,156; 1203 O.G. 63, at 84 (Oct. 10, 1997).

The proceedings herein are for a patent application and the provisions of 37 C.F.R. § 1.136 apply.

(complete (a) or (b), as applicable)

(a) ☐ Applicant petitions for an extension of time under 37 C.F.R. § 1.136 (fees: 37 C.F.R. § 1.17(a)(1)-(5)) for the total number of months checked below:

	Extension (months)	Fee for other than small entity	Fee for small entity
☐	one month	$ 110.00	$ 55.00
☐	two months	$ 410.00	$ 205.00
☐	three months	$ 930.00	$ 465.00
☐	four months	$ 1,450.00	$ 725.00
☐	five months	$ 1,970.00	$ 985.00

Fee: $________

If an additional extension of time is required, please consider this a petition therefor.

(check and complete the next item, if applicable)

☐ An extension for ______ months has already been secured, and the fee paid therefor of $ ______________ is deducted from the total fee due for the total months of extension now requested.

Extension fee due with this request $ ______________

or

(b) ☐ Applicant believes that no extension of term is required. However, this conditional petition is being made to provide for the possibility that applicant has inadvertently overlooked the need for a petition and fee for extension of time.

5. TOTAL FEE DUE

The total fee due is:

Appeal brief fee $ 160.00

Extension fee (if any) $ ______________

TOTAL FEE DUE $ 160.00

6. FEE PAYMENT

X☒ Attached is a X☐ check ☐ money order in the amount of $ 160.00

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☐ to Credit card as shown on the attached credit card information authorization form PTO-2038.

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X☒ Charge any additional fees required by this paper or credit any overpayment in the manner authorized above.

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7. FEE DEFICIENCY

NOTE: If there is a fee deficiency and there is no authorization to charge an account, additional fees are necessary to cover the additional time consumed in making up the original deficiency. If the maximum six-month period has expired before the deficiency is noted and corrected, the application is held abandoned. In those instances where authorization to charge is included, processing delays are encountered in returning the papers to the PTO Finance Branch in order to apply these charges prior to action on the cases. Authorization to change the deposit account for any fee deficiency should be checked. See the Notice of April 7, 1986, *1065 O.G. 31-33.*

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AND/OR

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☐ Credit card as shown on the attached credit card information authorization form PTO-2038.

WARNING: *Credit card information should* ***not*** *be included on this form as it may become public.*

Robert L. Farris

SIGNATURE OF PRACTITIONER

Date: January 14, 2004

Robert L. Farris

(type or print name of practitioner)

Reg. No.: 25,112

5291 Colony Drive North

P.O. Address

Customer No.:

Saginaw, Michigan 48603

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#
19/Brief of Appeal

IN THE UNITED STATES PATENT AN JTRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTEREFERENCES

APPLICANT: William R. Voigt

SERIAL NO: 09/766,025 ART UNIT: 3722

FILED: January 19, 2001

FOR: HELICAL ROTARY CUTTER AND METHOD

EXAMINER: Brian D. Walsh

Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

January 14, 2004

S i r:

APPELLANTS'BRIEF

This brief is submitted in support of appellant's appeal from the decision of the patent examiner dated July 14, 2003 finally rejecting claims 1, 3-8 and 11-15 under 35 U.S.C.§ 102(a) as being anticipated by Samuels et al., Claim 2 under 35 U.S.C. 103(a) as being unpatentable ever Samuels et al in view of Meis, and Claims 9 and 10 under 35 U.S.C.§ 103(a) as being unpatentable ever Samuels et al. A copy of the appealed claims appears in Appendix A attached hereto.

CERTIFICATION 37 C.F.R. 1.8a and 1.10
*(Express Mail Label number is **mandatory**)*
(Express Mail certification is optional).

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37 C.F.R. 1.8a

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37 C.F.R. 1.10

as "Express Mail Post Office to Addressee" Mailing Label No._EV336240425US **(mandatory)**

Bambi L. Straebel
Signature
Bambi L. Straebel

Date: January 14, 2004

(I). REAL PARTY IN INTEREST

William R. Voigt and Dennis F. Sauer, the applicants and appellants are the real parties in interest.

(II). RELATED APPEALS AND INTERFERENCES

There are no other appeals or interferences known to appellants' legal representative which will be directly affected by or have a bearing on the Board's decision in the pending appeal.

(III). STATUS OF THE CLAIMS

Claims 1, 3-8, and 11-15 are finally rejected under 35 U.S.C.§ 102(e) as being anticipated by Samuels et al. Claim 2 is finally rejected under 35 U.S.C.§ 103(a) as being unpatentable over Samuels et al Patent No. 6,247,389 (Appendix B) in view of Meis Patent No. 5,163,45 (Appendix C).

Claims 9 and 10 are finally rejected under 35 U.S.C.§103(a) as being unpatentable over Samuels et al.

(IV). STATUS OF AMENDMENTS

After the response by appellants filed January 2, 2003, no amendments to the claims were made or entered. The examiner considered the claims as amended January 2, 2003 and finally rejected claims 1-15 on July 14, 2003.

(V). SUMMARY OF THE INVENTION

Appellants invention relates to a helical rotary cutter for cutting a plurality of strands of hot plastic forced through an plurality of extrusion dies as the strand are being simultaneously cooled by water. The cutter cuts the strands into small plastic pellets. The pellets are fed mechanically from hoppers and heated to a molten state and formed

into a variety of products. These products can be molded or extruded. The melt can also be formed into film. The pellets must be cut cleanly on both ends to reduce or eliminate plastic hair like members on their ends. Hair members are objectionable because they inhibit feeding of pellets from storage hoppers.

Appellant's rotary cutters have a rotor with a plurality of grooves. That extend the length of the rotor. A first groove wall in a first wall plane extends axially from the left end to the right end, extends outward away from the rotor axis in the first direction of rotation and the first wall plane intersects the rotor axis. A plurality of first base support surfaces are each in a base support plane that is perpendicular to the first wall plane. The base support planes that are perpendicular to the first groove wall intersect each other. A plurality of rectangular flat cutter blades each have a base seated on one of the plurality of first base support surfaces. At least one clamp member clamps the plurality of first rectangular flat cutter blades to the first groove wall.

The plurality of first base support surfaces hold each rectangular blade clamped to the first groove wall with each cutting edge of each cutter blade the same radial distance from the rotor axis of rotation. The hourglass effect of each blade is reduced to less than one thousandth of an inch with the rotor dimensions disclosed in the specification. In addition to minimizing the hourglass effect, the base support surfaces also correct for the change in the radially height from one end to the other and of each and each cutter blade clamped to the first groove wall. The use of rectangular cutter blades makes it possible to replace damaged blades in the field without removing the rotor from the cutter thereby reducing down time to hours rather than weeks due to minor blade damage.

(VI) ISSUES

1. Whether Claims 1, 3-8, and 11-15 are anticipated by Samuels et al.
2. Whether Claim 2 is unpatentable over Samuels et al in view of Meis.
3. Whether Claims 9 and 10 are unpatentable over Samuels et al.

(VII). GROUPING OF CLAIMS

Dependent Claims 2-6 stand or fall together with independent Claim 1.

Dependent Claims 8-10 stand or fall together with independent Claim 7.

Independent Claim 11 stands or falls on its own merits.

Independent Claim 12 stands or falls on its own merits.

Dependent claims 14 and 15 stand or fall together with independent Claim 13.

(VIII). ARGUMENTS

1. Issue 1 – Whether Claims 1, 3-8 and 11-15 are anticipated by Samuels et al.

Claim 1 includes a plurality of first rectangular flat cutter blades clamped to the first groove wall. The base of each of the plurality of first rectangular cutter blades is seated on one of the plurality of first base support surfaces. The plurality of first base support surfaces are each in a base support plane that is perpendicular to the first wall plane and the first base support planes intersect each other. The first wall plane intersects the rotor axis. The first wall plane also extends outward from the rotor axis and in the direction of rotation. Each of the above limitations in Claim 1 is important. The first wall plane extending outward and in the direction of use is required to insure the blades cut rather than shear. It also insures that the first wall

plane does not include the axis of rotation. The first wall plane also intersects the rotor axis because there is a helix angle. The first base support surfaces intersect each other so that they can reduce the hourglass effect and correct for variation in the radial height of each rectangular cutter blade from one end to the other due to the helix angle. The plurality of cutter blades clamped to the first groove wall requires multiple blades on one wall in each groove and at least two intersecting base support surface planes associated with the first groove wall.

Samuels et al shows a rotor with a plurality of grooves and no helix angel. The blades are also intended to shear rather than cut. Figure 5A indicates that there is no helix angle. Each blade 2 extends the length of the rotor. There is one base support surface that cooperates with each groove wall. There are two base support surfaces associated with each wall surface plane. However, these base supports are 180° apart and are parallel to each other. Samuels et al does not provide any information on how the problems introduced by a helix angel would be handled. In view of the above Claim 1 is patentable over Samuels et a.

Claims 2-6 that are dependent on Claim 1 are patentable together with Claim 1.

Claim 7 includes a rotor having at least one groove, a first groove wall and a second groove wall. A plurality of first base support surfaces are perpendicular to the first wall plane and intersect each other. A plurality of second base support surfaces are each perpendicular to the second wall plane and intersect each other. A plurality of first rectangular flat cutter blades are each mounted on one of the plurality of the first base support surfaces. A plurality of second rectangular flat cutter blades are each

mounted on one of the plurality of second base support planes. A plurality of clamp members each clamp one of the plurality of first rectangular flat clutter blades to one of the plurality of first base supports and one of the plurality of second rectangular flat cutter blades to one of the plurality of second base supports. The first and second grove walls are part of the at least one groove. Samuels et al does not have at least one groove with all the structure set forth. Claim 7 is therefore patentable.

Claims 8-10 which are dependent upon Claim 7 are patentable together with Claim 7 for reasons set forth above.

Claim 11 is directed to a method of making a helical rotary cutter. The method includes machining a plurality of grooves in a steel cylinder. A first groove wall is machined in each of the plurality of grooves. A plurality of first base support surfaces in a plurality of first base support planes that intersect each other are machined in each of the grooves. A second groove wall is machined in each of the plurality of grooves. A plurality of second base support surfaces in a plurality of second base support planes that intersect each other are machined in each of the grooves. Rectangular cutter blades are mounted on each first base support and each second base support.

Samuels et al does not disclose or suggest a rotary cutter with a groove and a plurality of first base supports in first base support planes that intersect each other. Claim 11 is therefore patentable over Samuels et al.

Claim 12 includes a helical rotary cutter including a rotor with a plurality of grooves and a first groove wall. A plurality of first base support surfaces that are each in a base support plane that is perpendicular to the first wall plane and intersect

each other. A plurality of first rectangular flat cutter blades each have a base seated on one of the first base support surfaces. At least one clamp member clamps the plurality of first rectangular cutter blades to the first groove wall. Samuels et al does not suggest a groove with a plurality first base support surfaces in intersecting planes, plurality of a cutter blade each of which is seated on one of the base support surfaces and at least one clamp clamping the plurality of first rectangular blades to the first groove wall. Claim 12 is therefore patentable.

Claim 13 includes a helical rotary cutter with a rotor having a plurality of grooves, a first groove wall and a second groove wall. A first groove wall and a plurality of a first base support surfaces each in base support planes that intersect each other and at least one clamp member clamping the plurality of cutter blades to the first groove wall. Samuels et al does not show or suggest a plurality of cutter blades clamped to a first groove wall and to a plurality of base support support surface in intersecting planes. Claim 13 therefore patentable over Samuels et al.

Claims 14 and 15 are dependent on Claim 13 and are patentable together with claim 13 for reasons set forth above.

2. <u>Whether Claim 2 is unpatentable over Samuels et al in view of Meis.</u>

Claim 2 is dependent upon Claim 1 and is patentable over Samuels et al for reasons set forth above.

3. <u>Whether Claims 9 and 10 are unpatentable over Samuels et al.</u>

Claims 9 and 10 are dependent on Claim 7 and are patentable together with Claim 7 for reasons set forth above. It is also noted that Claim 9 includes four first base support surfaces and four second base support surfaces. Each of the first

base support surfaces is cooperates with first groove walls and is in a plane that is perpendicular to the groove wall. Samuels et al discloses two walls that are 180 apart and in a common wall plane. There are only two base support planes that are perpendicular to one plane of Samuels et al. Claim 9. The four planes are different from each other. No two of the rotor sections disclosed in the application are identical in size or shape.

(IX). APPENDIX

A. Claims

B. Samuels et al Patent No. 6,247,389

C. Meis Patent No. 5,163,490

It is believed that all the claims on appeal are clearly patentable over the prior art of record. Accordingly, reversal of the final rejection and allowance of the application are requested.

Respectfully submitted,

William R. Voigt

By his attorney,

Robert L. Farris

Robert L. Farris
Registration No. 25,112
5291 Colony Drive North
Saginaw, Michigan 48603
(989) 799-5300

bls

A

CLAIMS

Claim 1 was rejected as anticipated by Samuel et al. Applicant respectfully traverses the rejection. Claim 1 includes the first groove wall in a first wall plane that intersects the rotor axis, a plurality of first base support surfaces that are each in a base support plane that is perpendicular to the first wall plane and wherein all the base support planes that are perpendicular to the first groove wall intersect each other. Applicant's wall planes all cross the axis 12 due to the helix angle (see figure 3) and all intersect each other due to their extension away from the rotor axis and in the direction of rotation (see figure 4). Therefore, only the plurality of first base support surfaces 30, 40, 42 and 40 that cooperate with a first wall plane are perpendicular to the first wall plane. All the other wall planes of the rotor intersect the first wall plane and each other and are not there for parallel. Samuel et al discloses blades 2 which are parallel to a blade on the opposite side of the body 17 when there is no helix angle. The base support surfaces adjacent to the blade walls that are 180° apart are in planes that are perpendicular to two parallel blade walls. This relationship is easy to visualize in two dimensions in Fig. 3 of Samuel et al. Note that Samuel et al discloses only one blade base surface that cooperates with one blade wall to position a blade. If Samuel et al employs multiple short

blades in place of one blade extending the length of the body, these blades would all set on the one blade surface in one base surface plane. When a helix angle is provided, the relationship between the blades and the blade positioning surfaces all change. Samuel et al mentions a helix angle but does not discuss how the changed relationships would be accommodated.

Samuel et al does not disclose a rotary cutter with a helix angle, a first groove wall and a first wall plane and a plurality of first base support surfaces that are each in a base support plane that is perpendicular to the first wall plane and wherein all the base support planes that are perpendicular to said first groove wall intersect each other as set forth in claim 1 and explained above. Claim 1 is therefore allowable over Samuel et al.

Claim 2 was rejected as unpatentable over Samuels etal in view of Meis. Applicants respectfully traverses the rejection. Meis discloses a rotor with channels 14. The channels have walls 15 and a base that is perpendicular to the wall. The walls 15 on opposite sides of the rotor are parallel to each other. Their adjacent bases are also in parallel planes. Meis does not appear to suggest a helix angle. Meis does not therefore disclose structure set forth in parent Claim 1 that is not found in Samuels et al as explained above. Claim 2 is therefore allowable together with parent claim 1.

Claim 3 was rejected as anticipated by Samuels etal. Applicants respectfully traverses the rejection. All of the first based support surfaces of Samuels et al, that are perpendicular to the first wall plane, are parallel to each other. Claim 3 is therefore allowable together with parent claim 1 for reasons set forth above.

Claim 4 was rejected as anticipated by Samuels et al. Applicants respectfully traverse the rejection. Claim 4, which is dependant upon claim 1, includes a second groove wall in a second wall plane that intersects the rotor axis, a plurality of second base support surfaces that are perpendicular to the second groove wall and that are each in a second base support plane that is perpendicular to the second wall plane and the second base planes intersect each other. The second wall groove of Samuels etal does not have a plurality of second based support planes that are perpendicular to the second wall plane and intersect each other. The base support planes of Samuels etal that are perpendicular to a radius and parallel to the rotor axis are parallel to each other. They do not intersect even when there is no helix. Claim 4 as well as parent claim 1 both distinguish over Samuels etal as explained above. Claim 4 is therefore allowable.

Claim 5 was rejected as anticipated by Samuels et al. Applicant respectfully traverses the rejection. Claim 5 is dependent upon claim 4 and is allowable together with claim 4 for reasons set forth above.

Claim 6 was cancelled. The parent claims, as amended, include all the subject matter of claim 6.

Claim 7 was rejected as anticipated by Samuels et al. Applicants respectfully traverse the rejection. Claim 7 is similar to claim 1 with the cutter blades added. The claim includes a plurality of first base support surfaces that are each in a base support plane that is perpendicular to the first wall plane and all the base support planes intersect each other. The wall plane extends outward away from the rotor axis and in the direction or rotation. A plane is a flat surface containing all the straight lines connecting any two points on the surface. Since any two points can be separated apart any desired distance, the plane can extend out in any direction toward infinity. A plane cannot therefore intersect itself. For one plane to intersect another there must be an angle of less than 180° between the planes. Samuels etal shows a flat cutter base support. That surface is in one plane. The specifications suggest that multiple blades can be mounted on each cutter based support. Regardless of the number of cutter blades, there is only one blade based support plane disclosed by Samuels et al for each wall plane. The base support surfaces shown in Figures 5B and 5C of Samuels etal are tangents of a circle. The base support surfaces that are 180 degrees apart are parallel to each other if the first and second wall planes include a common radius. If there is a helix angle, two blade wall planes will not be parallel.

When viewed from an end, as seen in applicants Figure 4, one wall plane will extend axially into the left while a second wall plane spaced 180° about the axis of rotation will extend axially to the right due to the helix angle (in a plane that is transverse to the axis of rotation). The wall planes as viewed from an end, as shown in Figure 2, also intersect each other due to ``extending outward from the rotor axis in the direction of rotation as set forth in claim 7. No two wall planes of applicants' cutter are parallel. Since the wall planes intersect each other a base support plane that is perpendicular to one wall plane will not be perpendicular to another wall plane of the rotor as claimed. Samuel et al discloses only one base support plane that is perpendicular to one wall plane if the rotor is modified to have a helix angle and the angle 22 shown in Figure 4 is negative. In view of the above claim 7 distinguishes over Samuel et al and is allowable.

Claim 8 was rejected as anticipated by Samuels et al. Claim 8 is dependant upon claim 7 and is allowable together with claim 7 for reasons set forth above.

Claim 9 was rejected as unpatentable over Samuels et al. Claim 9 is dependant upon claim 7 and is allowable together with claim 7 for reasons set forth above. It is also noted that Samuels et al does not explain how multiple blades could be clamped to one wall plane.

Claim 10 was rejected as unpatentable over Samuels et al. Applicants respectfully traverse the rejection.

Claim 10 is dependant upon claim 9 and is allowable together with claims 7 and 9 for reasons set for above. When there are four cutter blades on one groove wall, the blade support surface for each blade must be in a different position relative to the adjacent grooved wall to minimize the hour-glass effect as explained in the specification. The wedge blocks have wedged face surfaces. These surfaces are also wedge shaped from one end to the other as explained in the paragraph starting on page 7, line 8 of Applicants' specification. The system is clearly not just a multiplication of parts. The location of the based surfaces 30, 40, 42 and 44 vary as shown in figure 9. The distance between the blades of one groove wall relative to the blades of the facing groove wall changes as the distance from the axis of rotation changes. The rectangular wedges shown in Figure 9 of Samuels et al will not work if you compensate for the hour-glass effect and have a helix angle. With Applicants' claimed rotary cutter, the angle between a radius and a wall plane changes from one end of each wall surface to the other end.

Claim 11 was rejected apparently as anticipated by Samuels et al. Applicants respectfully traverse the rejection. Claim 11 includes machining a first groove wall in each of a plurality of grooves that is in a first wall plane extending axially from the left cylinder end wall to the right cylinder end wall and in a first wall plane that intersects the rotor axis, and machining a plurality of

first based support surfaces in each of said plurality of grooves that are each in one of a plurality of first based support planes that are perpendicular to the first wall plane and with the plurality of first based support planes intersecting each other and wherein the right end and the left end of each of the first based support surfaces are spaced equal distance from the rotor axis.

Samuels et al discloses groove walls in Figures 5B and 5C that are on a radius in one transverse plane through the rotor. When there is a helix angle, the groove wall is radial at only one place along the entire length of the groove wall. As a result, when there is a helix angle, two identical rotors can not be placed end to end to obtain a longer rotor with increased length that form a groove wall in one plane extending the length of the rotor. Applicants' rotor is not a mere duplication of parts. Samuels et al has only a single blade base in a single base plane associated with each groove wall. Claim 11 clearly sets forth a plurality of first base support surfaces in each of a plurality of grooves that are each in one of a plurality of first base support planes that are perpendicular to the first wall plane and with the plurality of first base support planes intersecting each other. Samuels et al does not disclose or suggest any such structure. Claim 11 therefore clearly distinguishes over Samuels et al and is allowable.

Claim 12 was rejected as anticipated by Samuels et al. Applicants respectfully traverse the rejection. Claim 12 includes a helical rotary cutter with a first groove wall in a first wall plane extending auxiliary from the left end to the right end and extending outward away from the rotor axis and in the direction of rotation, a plurality of first base support surfaces that are each in a base support plane that is perpendicular to the first wall plane and wherein all the base support planes that are perpendicular to the first groove wall intersect each other, and a plurality of flat cutter blades each of which has a base and cutting edge that is parallel to the base. With this structure no two first wall planes are parallel to each other. It therefore follows that the plurality of first base support planes 9 are perpendicular to only one first wall plane. Samuels et al discloses only one base support plane associated with each wall plane when the blade is helical and the angle 22 shown in Figure 4 is negative. In column 4 on lines 21 and 22, Samuels et al states ``Preferably all, of the knives 18 run the full length of 17.'' In column 3, line 42 it is stated ``(of course more than one knife may be present).'' This language most likely means that there are multiple knives 18 that extend the full length of the body 17. It would also be possible to replace one knife 18 with two or more short knives each of which is positioned by one first base support plane. Samuels et al does not show and is not

believed to suggest applicants' structure as set forth in claim 12. Claim 12 is therefore allowable.

Claim 13 was rejected as anticipated by Samuels et al. Applicants respectfully traverse the rejection. Claim 13 includes a rotor with a plurality of grooves each of which has a first groove wall in a first wall plane. The first wall plane extends the length of the rotor and extends outward from the rotor and in the direction or rotation. The first wall plane also intersects rotor axis. The first wall plane as described in claim 13 intersects the rotor axis and all the first and second wall planes. Therefore none of the wall planes are parallel to each other. Claim 13 also includes a plurality of first base support surfaces that are each in a base support plane that is perpendicular to the first wall plane and were in all the base support planes that are perpendicular to the first groove wall intersect each other. Samuel et al discloses only one base support plane that is perpendicular to one first wall plane. Multiple blades can be mounted on each of the Samuel et al base support planes. There will be however, only one base support plane associated with each wall plane if the Samuel et al cutter has a helix angle. Samuel et al does not show or suggest the structure set forth in Applicants claim 13. Claims 13 therefore allowable.

Claim 14 was rejected as anticipated by Samuels etal. Applicants respectfully traverse the rejection.

Claim 14 is dependant upon claim 13 and is allowed together with parent claim 13 for reasons set forth above.

Claim 15 was cancelled. The subject matter of the parent claims include the subject matter of 15.

b

US006247389B1

(12) **United States Patent**
Samuels et al.

(10) **Patent No.:** **US 6,247,389 B1**
(45) **Date of Patent:** **Jun. 19, 2001**

(54) **POLYMER CUTTING APPARATUS AND METHOD**

(75) Inventors: **Michael Robert Samuels**, Wilmington, DE (US); **Marion Glen Waggoner**, Landenberg, PA (US)

(73) Assignee: **E. I. du Pont de Nemours and Company**, Wilmington, DE (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/479,709**

(22) Filed: **Jan. 7, 2000**

Related U.S. Application Data

(63) Continuation of application No. PCT/US97/17630, filed on Sep. 29, 1997.

(51) **Int. Cl.**[7] **B26D 1/00**

(52) **U.S. Cl.** **83/13**; 83/349; 83/508.3; 83/674

(58) **Field of Search** 83/674, 349, 508.3, 83/99; 30/346.55, 357

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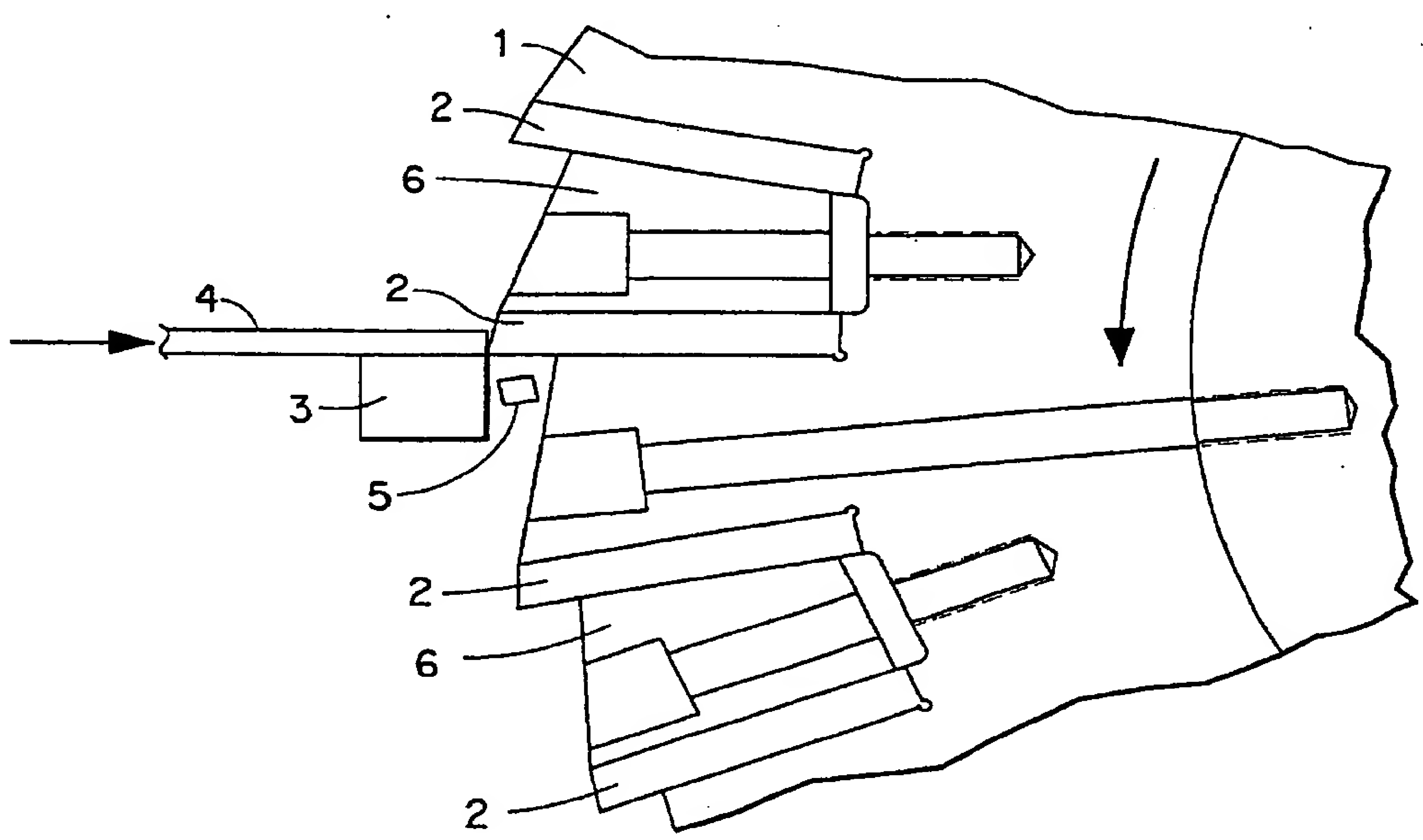
Primary Examiner—M. Rachuba
(74) *Attorney, Agent, or Firm*—Thomas H. Magee

(57) **ABSTRACT**

A polymer cutter with a rotary cutting head in which the cutting edges are on the circumferential periphery of the head, and in which the cutting edges shear rather than slice the polymer is described. The knife blades on the rotary head have a cutting edge angle of greater than 70°. The apparatus is especially useful for cutting thermoplastics and may be used for preparing polymer granules or pellets.

20 Claims, 6 Drawing Sheets



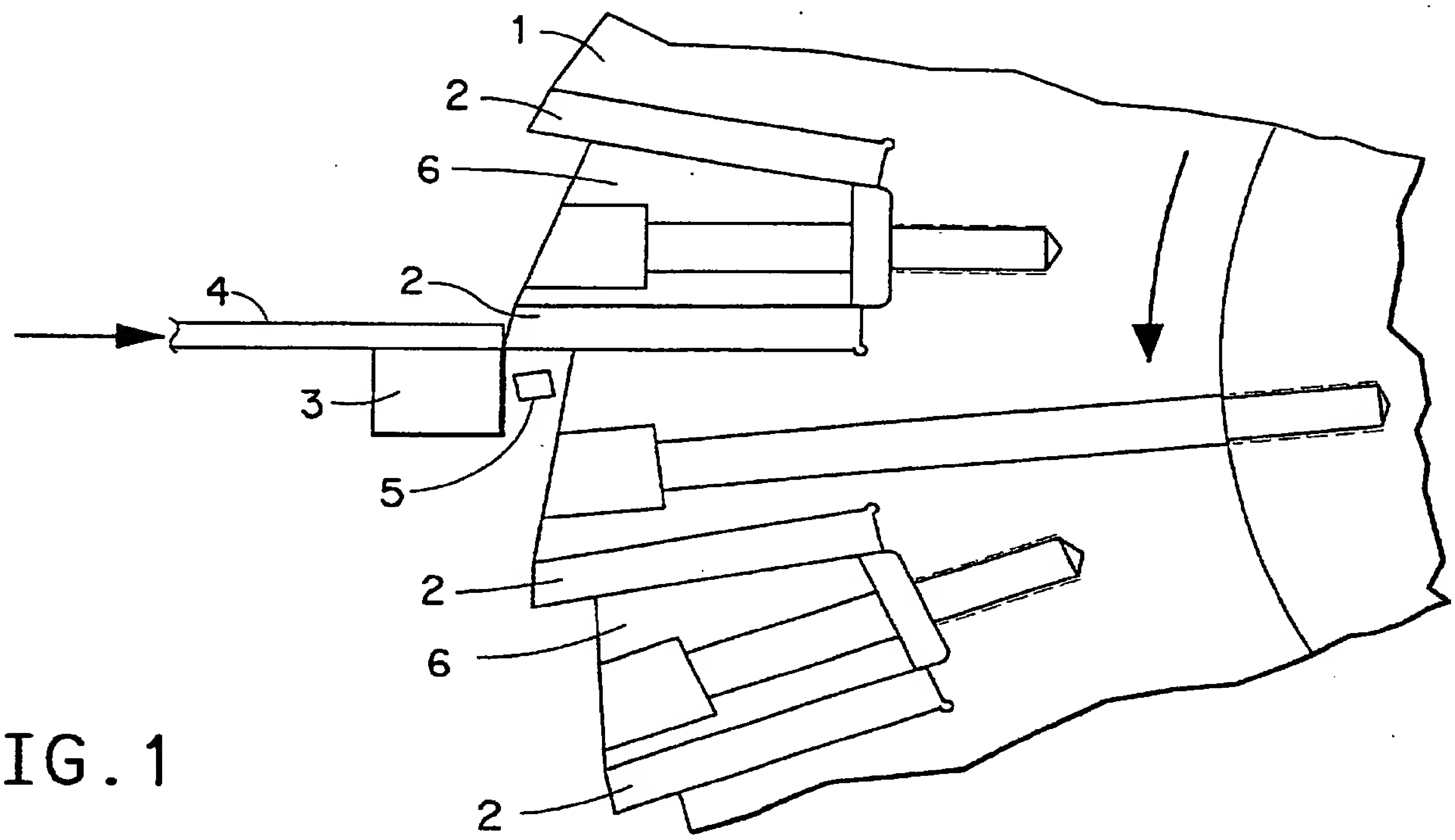


FIG.1

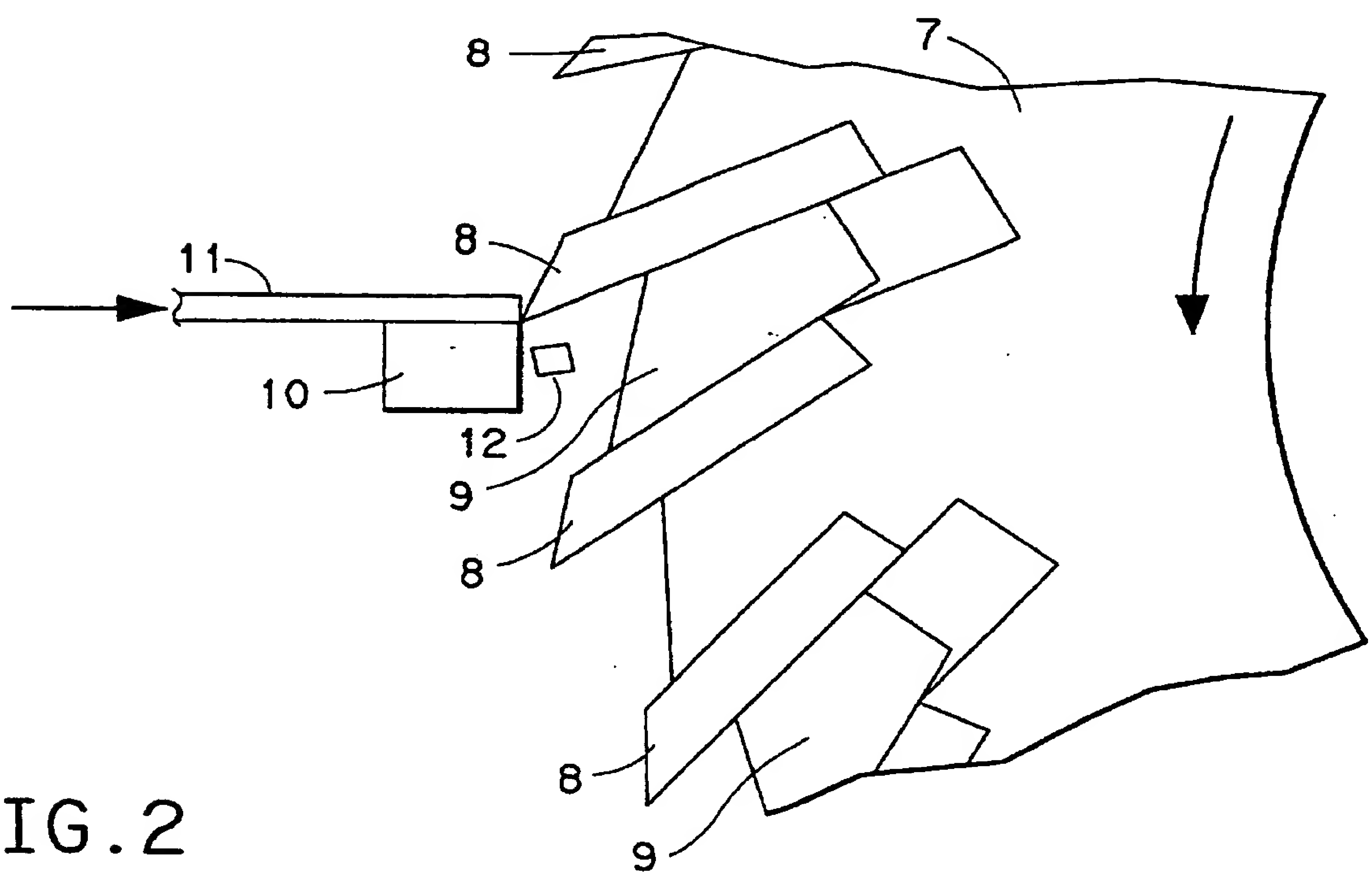


FIG.2

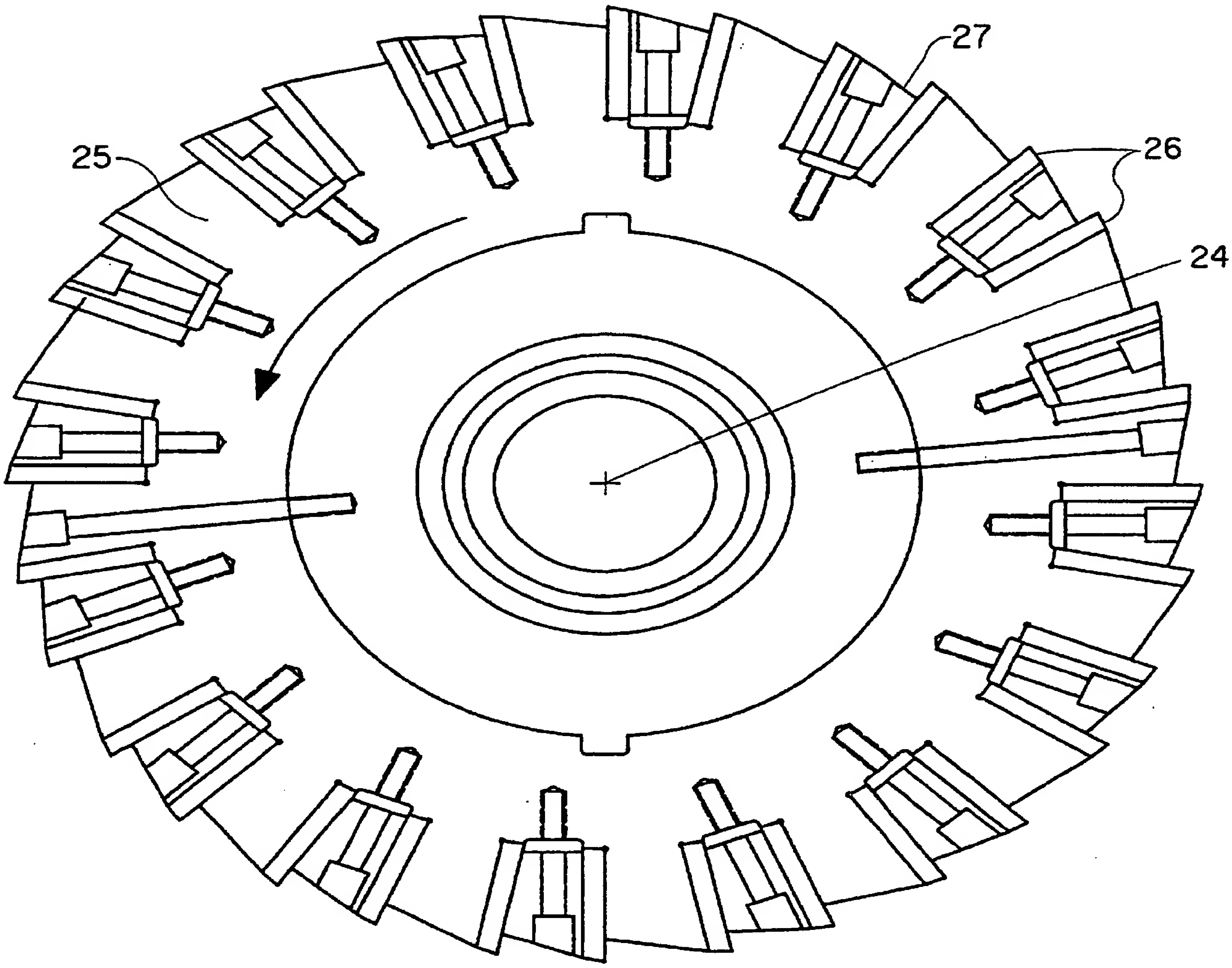


FIG.3

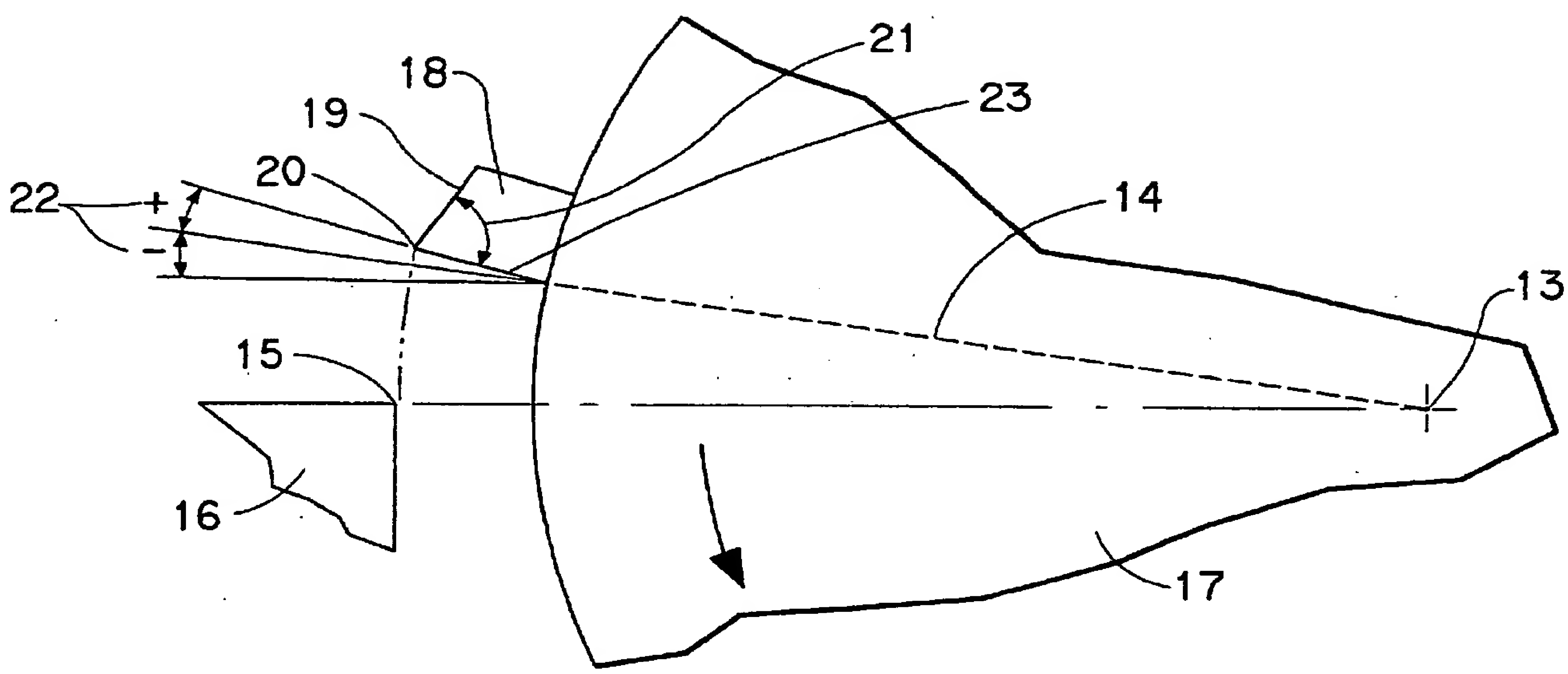


FIG.4

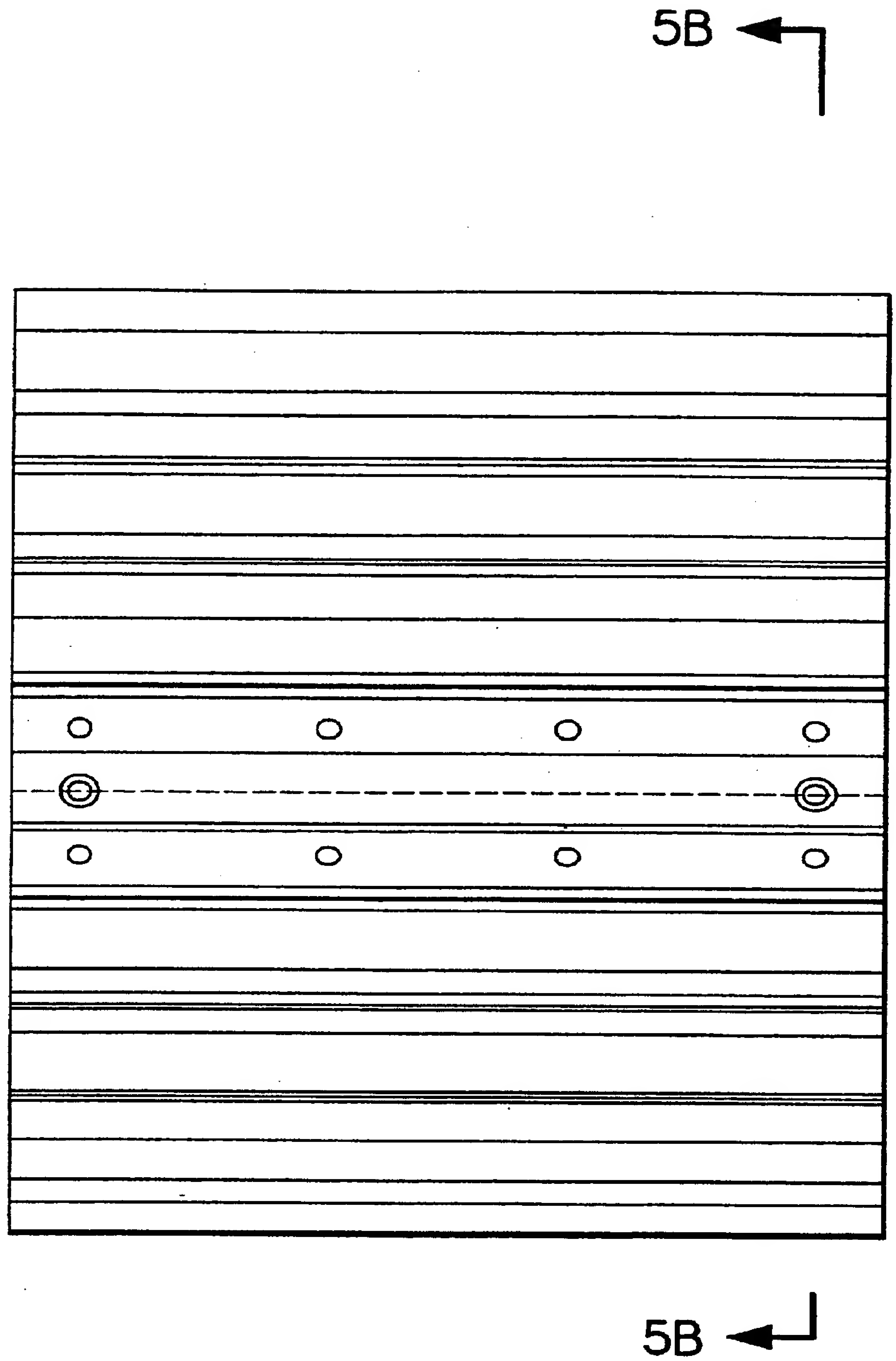
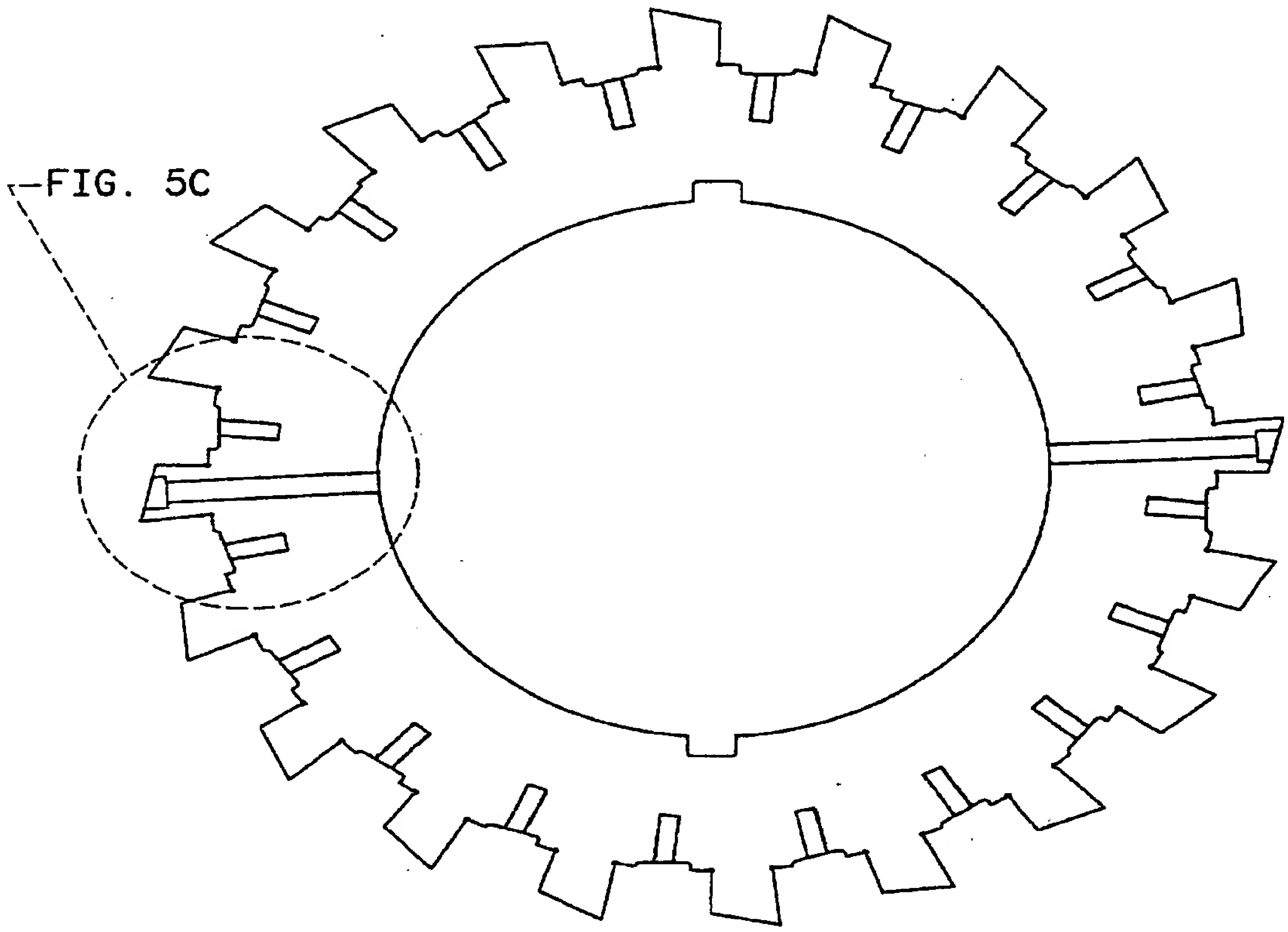


FIG.5A

FIG.5B



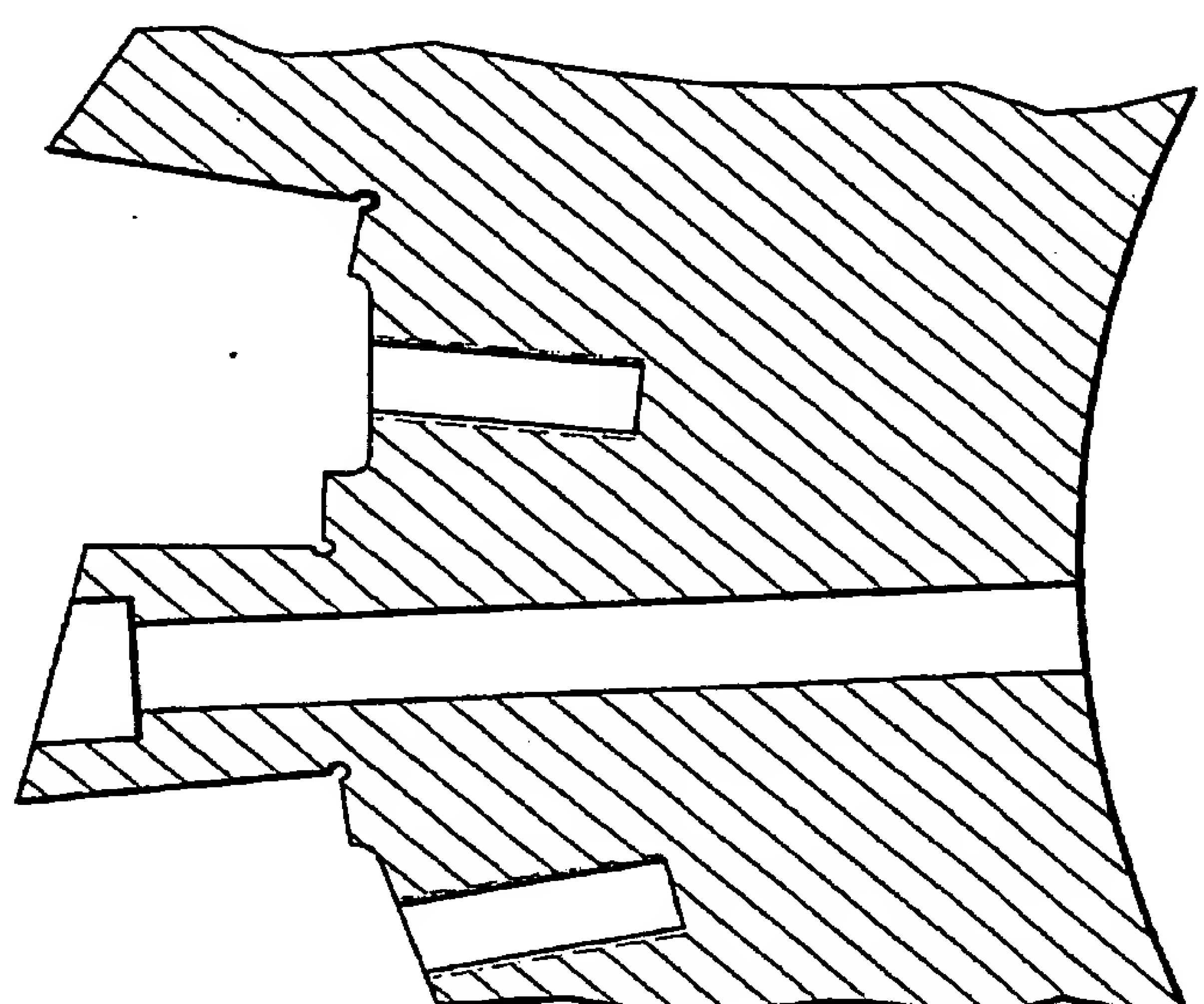


FIG.5C

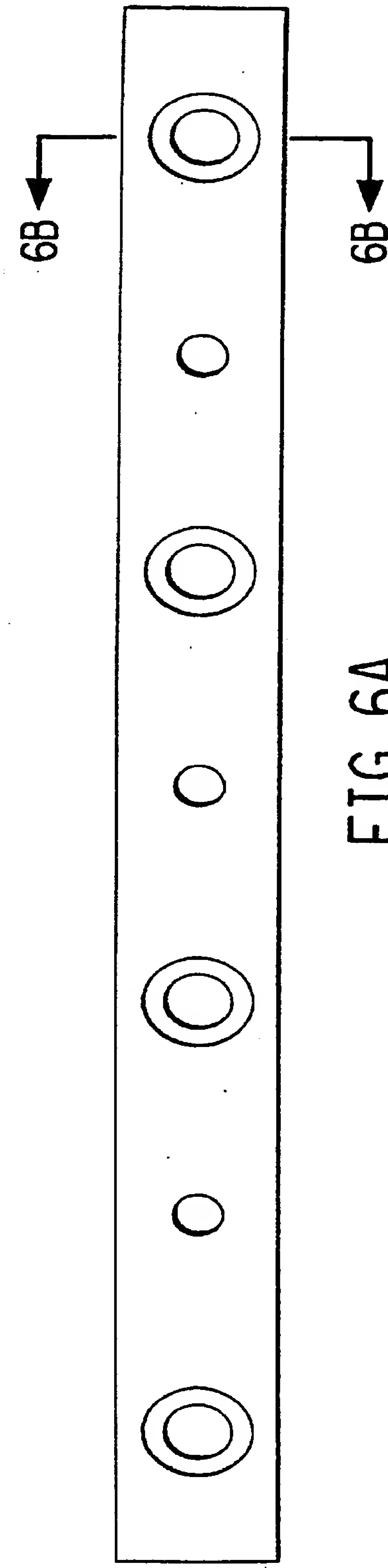


FIG.6A

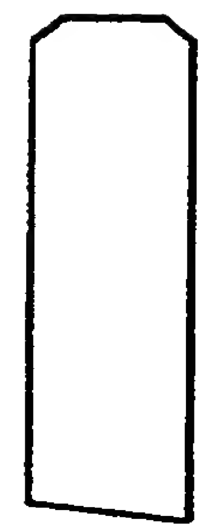


FIG.6C

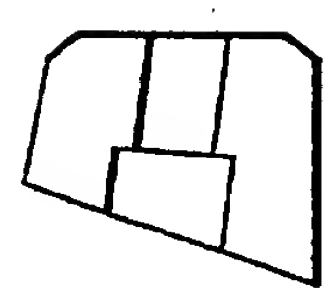


FIG.6B

POLYMER CUTTING APPARATUS AND METHOD

This application is a continuation of PCT/US97/17630 filed Sep. 29, 1997.

FIELD OF THE INVENTION

This invention concerns a rotary cutting head for cutting polymer, especially polymer strands and the like, and a process for cutting polymer using this head.

TECHNICAL BACKGROUND

Polymers are abundant and important items of commerce, being useful in a myriad of applications. During handling, processing or reclamation of polymers it is often necessary to cut the polymers into smaller pieces of various sizes and/or configurations. For instance, when thermoplastics are produced they are often cut into pellets or granules of relatively small size so they can be easily fed to a forming machine such as an injection molding machine or an extruder.

Cutters for polymers are available in many forms. In one common form a rotary head containing knives approximately parallel to the axis of rotation is used to cut polymer against a bed knife as the polymer is being fed into the cutter head. Such a cutter is pictured schematically in FIG. **2**. In these cutters the knives are such that they cut by a slicing action, with a narrow leading cutting edge slicing through the polymer. While cutters of this type have been popular for many years, they have certain drawbacks. Among these is cutter knife breakage and/or wear, especially when hard and/or abrasive polymers are being cut. It is believed that when knives with sharp acute cutting angles are used, the small amount of metal at the cutting edge makes that edge relatively weak and prone to breakage and/or relatively fast wear. When breakage or excessive wear occurs, the cut quality is adversely affected, and the cutter must be shut down to resharpen or replace the worn or broken blades. This downtime is expensive in both actual maintenance costs and lost production time, and a polymer cutting apparatus which can cut at high speed with good cut quality, while at the same time requiring less downtime, would be advantageous.

SUMMARY OF THE INVENTION

This invention involves a rotary cutter head having an axis of rotation, comprising, one or more knives, each knife having a cutting edge on a circumferential periphery of said rotary cutter head, each knife having a knife angle of about +10° to about −15°, and a cutting edge angle of 70° or more, and provided that no point on a cutting face of said knife is further from said axis of rotation of said rotary cutter head than said cutting edge.

Also described herein is a rotary cutter for cutting polymer, comprising, a bed knife, a rotary cutter head, and a means for advancing polymer into said rotary cutter head, and wherein said rotary cutter head has an axis of rotation and one or more knives, each knife having a cutting edge on a circumferential periphery of said rotary cutter head, each knife having a knife angle of about +10° to about −15°, and a cutting edge angle of 70° or more, and provided that no point on a cutting face of said knife is further from said axis of rotation of said rotary cutter head than said cutting edge.

This invention also concerns a process for cutting polymer with a rotary cutter, wherein the improvement

comprises, using a rotary cutter head which has an axis of rotation and one or more knives, each knife having a cutting edge on a circumferential periphery of said rotary head, each knife having a knife angle of about +10° to about −15°, and a cutting edge angle of 70° or more, and provided that no point on a cutting face of said knife is further from said axis of rotation of said rotary head than said cutting edge.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** shows a cross section perpendicular to the axis of rotation of part of a typical rotary cutting head of this invention, together with a bed knife, a polymer strand and a cut polymer particle.

FIG. **2** shows a cross section perpendicular to the axis of rotation of part of a typical rotary cutting head of conventional design, together with a bed knife, a polymer strand and a cut polymer particle.

FIG. **3** shows a cross section perpendicular to the axis of rotation of a typical rotary cutter head of this invention.

FIG. **4** shows schematically important elements of a rotary cutter head of this invention, as defined herein.

FIG. **5** shows the body of the rotary cutter head used in the Example, with dimensions shown in cm. FIG. ***5a*** shows a plan view of the body, while FIG. ***5b*** shows a cross section of the body perpendicular to the axis of rotation. FIG. ***5c*** shows a detailed section of FIG. ***5b***, as indicated.

FIG. **6** shows a wedge and a cutter blade used in the rotary cutter head of the Example, with dimensions in cm. FIG. ***6a*** is a wedge, both in plan view and cross section, and FIG. ***6b*** is a cross section of a cutter blade.

DETAILS OF THE INVENTION

By a polymer herein is meant a polymer itself containing no additives, as well as polymers containing any additive or any combination of additives normally found in polymers. Such additives include pigments such as TiO_2, antioxidants, antiozonants, toughening agents, flame retardants, lubricants, dyes, antistatic agents, antistaining agents, and fillers and reinforcing agents such as talc, clay, carbon black, milled glass, glass fiber, carbon fiber, and aramid fiber. Preferred polymers are plastics (as opposed to elastomers), and thermoplastics are especially preferred.

FIG. **1** is a general view of a cross section of part of a rotary cutter head, and other parts of a cutting apparatus, according to this invention. The parts of the rotary cutter head shown are **1** the rotary cutter head body which rotates in the direction shown, several knives **2**, and two wedges **6** which hold the knives in place on **1** (as with bolts, whose holes are shown, but the bolts are not shown). Also shown is a stationary bed knife **3** whose mounting is not shown, a polymer strand **4** which is being fed in the direction shown, and a polymer granule **5** which has just been cut.

In contrast FIG. **2** shows a similar view of a conventional polymer cutter which has rotary cutter body **7**, several knives **8**, and wedges **9** to hold the knives in place. Also shown are a bed knife **10**, polymer strand **11**, and cut polymer granule **12**.

As can be seen by a general comparison of FIGS. **1** and **2**, the major difference between the instant invention and the conventional cutter is that the conventional cutter acts in a cutting mode, much as a razor blade does in cutting a beard, while the cutter of this invention acts more by shearing off the polymer. In both cutters it is preferred that clearance between the cutting edge of each knife and the bed knife be as small as practicable. This tends to give the cleanest cut,

and is usually about 0.025 to about 0.25 mm, preferably about 0.050 to about 0.12 mm.

Generally speaking, in such cutters the polymer is advancing into the rotor knives continuously, so after the cutting edge of each knife passes the bed knife, each cutter knife is raked away from the edge of the bed knife. In other words, the point on the knife furthest away from the axis of rotation of the rotary cutter head is normally the cutting edge of the knife, and all points on the cutting edge face are closer to the axis of rotation of the rotary cutter head than the cutting edge. Furthermore, if applicable, the rotary cutter head or its parts other than the knives are also preferably designed to allow the polymer to advance. In the case of FIG. 1, the rotor body and wedges are raked away from the periphery of the cutter head as shown. Other designs will be obvious to the artisan to accomplish this.

The knives may be separate parts which can be removed from the rotary cutter head for sharpening or replacement, or other configurations are possible, which can be held in the rotary cutter head by bolts, or as shown by wedges. Or the rotary cutter head may be a single piece of metal, with the knife edges hardened. This eliminates much machining of wedges, holes, etc., which are shown in FIG. 1. This is particularly useful where the knife edges don't chip or need sharpening very often.

FIG. 3 shows a cross section perpendicular to the axis of rotation of a full rotary cutter head according to this invention. This head has a center of rotation **24**, a body **25**, a multiplicity of knives **26**, held to the body with a multiplicity of wedges **27**. In operation the head rotates in the direction shown.

FIG. 4 is a schematic diagram showing important elements of the rotary cutter head of this invention and their relationship to each other. Also included for completeness is a bed knife. The rotary head cutter of FIG. 4 has an axis of rotation **13**. For convenience in explanation a dashed line **14** (which is in fact a radius) has been drawn from **13** to the point at which a knife, **18** protrudes from **17**, the cutter body. Also included in FIG. 4 is a bed knife **16** having cutting edge **15**. Protruding from the body **17** of the rotary cutter head is knife **18** (of course more than one knife may be present), which has knife cutting face **19**, and cutting edge **20**. In addition the knife also has cutting edge angle **21**, a knife forward surface **23**, and knife angle **22**. **22** is measured from a radius such as **14** extended through the point at which **18** protrudes from **17**. Positive and negative angles of **22** are indicated on FIG. 3.

Normally the position of **16** and **17** will be such that **15** will be approximately parallel to **13**, and this position also will preferably minimize the clearance between **15** and **20** when the rotary cutter head is in operation.

The cutting edge angle of the knife, **21**, is at least 70° or more, preferably about 80° or more. This angle is the angle between the knife cutting face **19** and the knife forward surface **23**. If one or both of **19** and **23** is (are) curved, then **21** is taken as the angle between the tangent and the other arm of the angle or between the two tangents, (on one or both of **19** and **23**) at **20**. The maximum value of **21** is determined by **22** and the requirement that no part of **19** be further from **13** than **20**. Since **21** is a relatively large angle, there is a considerable amount of metal (or other knife material) around, and especially in back of, **20**. It is believed that this material near the cutting edge makes **20** stronger, and thus less prone to chip. The massive amount of material about **20** also is believed to retard wear, thus reducing the frequency at which **20** must be resharpened.

In addition, **22** is the angle between a radius from **13**, and **23** (or a tangent to **23** at **20** if **23** is a curved surface), and is about +10° to about −15°, preferably about 0° to about −5°, and especially preferably about 0°. If **22** is too positive, the shearing action of **20** against **15** may be impaired, therefore leading to poorly cut polymer, and if **22** is too negative, it may not be possible to make **21** large enough.

No point on **19** should be further away from **13** than **20**. This follows simply from the fact that one normally prefers to have **20** as close to **15** as is practicably while polymer is being cut. If any part of **19** is further from **13** than **20**, one simply will not be able to place **20** as close to **15** as is preferred, without having **19** strike **15** when **17** is rotating. Of course as **20** suffers some wear from cutting polymer, a small portion of **19** immediately adjacent to **20** may be further from **13** than the actual edge of **20**. This is permissible, but of course when **20** becomes badly worn it will preferably be sharpened to maintain a good polymer cut quality.

It is preferred, although not necessary, that some, and more preferably all, of the knives **18** run the full length of **17**. This is shown in FIG. 5.

Across the length of **17** (perpendicular to the cross section shown in FIG. 3), **20** may be parallel to **13**, or may be helically disposed to **13**, with essentially the entire length of **20** being at a constant distance from **13**. A preferred helical angle is about 0° to about 3° from **13**. When **17** is quite long, and for instance may be cutting many strands of polymer, the overall strain on any knife is lessened if that knife contacts the polymer strands in sequence, as it would do if the blade was helically disposed about **13**.

This invention also includes an apparatus for cutting polymers which includes the rotary cutter head described above, a bed knife, and a means for advancing polymer into the rotary cutter head. The bed knife is a usually stationary item that is placed so that clearance between the knives of the rotary cutter head **18** pass as close to the bed knife as reasonably possible while the rotary cutter head is rotating. The "knife edge" of the bed knife will usually have an angle of about 90°, and serves to keep the polymer from bending or otherwise moving as the knives **18** strike the polymer. Most commonly, the polymer is fed over a surface of the bed knife into the rotary cutter head, as shown in FIGS. 1 and 2.

The polymer **4** or **11** is usually advanced continuously as shown in FIGS. 1 and 2, respectively, into the path of the knives **2** or **8** of the rotary cutter head. This requires a means for advancing the polymer. If the cutter apparatus is so disposed the polymer may "fall" into the rotary cutter head by gravity. More commonly though the polymer is fed by means of one or more pairs of feed rolls or a pair of feed conveyors. By feed rolls is meant a pair of rolls having a nip between them. Polymer is fed into the nip and the rolls are driven to move the polymer through the nip and into the rotary cutter head. A feed conveyor is similar, being a conveyor-like apparatus with two conveyor belts with the polymer being driven between the belts. The polymer may simply be fed by being extruded from a die, the movement though and out of the die being the feed mechanism to the rotary cutter head. Other methods of feeding are known.

Inherent in the above discussion is a description of a process for cutting polymer using the rotary cutter head described herein. Many different shapes of polymer may be cut, such as sheets, strands, ribbons and tubes, especially thick-walled tubes. If the polymer to be cut is too thin, such as a small diameter fiber or a thin film the polymer may bend and may or may not be cut, but even if cut the cut may not

be of good quality, i.e., be ragged, generate fumes (smaller particles than desired) or cut only partially or unevenly. It is preferred that the smallest cross sectional dimension of the polymer to be cut is about 1 mm or more, preferably about 2 mm or more. The maximum dimension will depend on the polymer being cut as well as the power of the power of the cutter apparatus and the mechanical stress the cutting apparatus can endure.

One preferred form to be cut is one or more polymer strands. By a strand is meant a rod-like essentially continuous length of polymer whose largest cross sectional dimension is no more than 6 times, preferably no more than 3 times, and more preferably no more than 2 times greater than its smallest cross sectional dimension. A preferred cross sectional for a strand is approximately circular or square, with circular being especially preferred. It is preferred that the largest cross sectional dimension of the strand be about 1 to about 8 mm, preferably about 2 mm to about 4 mm. Cutting of strands into relatively short pieces, about 1 to about 8 mm long, or expressed another way the length to diameter ratio of the pellet is about 1, gives an especially useful form of polymer usually called pellets or granules. This is the most common form of solid polymer which is fed to injection molding machines, extruders, and the like.

EXAMPLE

A Model 3508 cutter made by Conair Corp., Bay City, Mich, U.S.A. was used to cut circular cross section polymer strands. The cutter head was used is shown in FIGS. 5 and 6. The diameter of the strands entering the cutter was about 2.3 mm, and the length of the pellet produced was about 2.5 mm. The strands were extruded through die holes about 4.0 to 4.5 mm in diameter and the strands (while molten) were drawn down to about 2.3 mm diameter by the feed mechanism of the cutter. The clearance between the rotor knives and the bed knife was nomially 0.076 mm.

During routine operation, an average of about 545 kg/h of pellets were produced, with the range being about 455 to about 635 kg/h. This entailed feeding 10 to 20 polymer strands at a linear rate of about 60 to about 90 m/min. The maximum rotor speed was 1800 rpm, which was adjusted to produce pellets as described above.

Over a period of about 4 months (about 1,005 actual operating hours) a total of about 450,000 kg of polymer was processed through the cutter as described above. All of this polymer was glass fiber filled, the glass fiber contents ranging from 13 to 45 percent by weight. Smaller amounts of other materials such as carbon black were also present in some of the polymer.

The individual polymers cut at different times were poly (ethylene terephthalate), poly(butylene terephthalate), nylon-6,6 and a polyamide containing both aromatic and aliphatic repeat units. All of these polymers gave a good cut throughout the test, with for instance the amount of fines being produced at the beginning and end of the test on various polymers not differing much. The results were also comparable to those which were usually obtained with the same cutter using a conventional type rotary cutter head, as shown in FIG. 2.

Wear on the knife edges at the end of this test was measured as 0.032 mm. It is difficult to compare this wear to the wear on knife edges from a conventional cutter because of the varying geometry of the knife edge, and the effect of such wear may have on cut quality.

What is claimed is:

1. An apparatus which is a rotary cutter head having an axis of rotation, comprising, one or more knives, each knife having a cutting edge on a circumferential periphery of said rotary cutter head, each knife having a knife angle of about +10° to about −15°, and a cutting edge angle of 70° or more, and provided that no point on a cutting face of said knife is further from said axis of rotation of said rotary cutter head than said cutting edge.

2. An apparatus for cutting polymer, comprising, a bed knife, a rotary cutter head, and a means for advancing polymer into said rotary cutter head, and wherein said rotary cutter head has an axis of rotation and one or more knives, each knife having a cutting edge on a circumferential periphery of said rotary cutter head, each knife having a knife angle of about +10° to about −15°, and a cutting edge angle of 70° or more, and provided that no point on a cutting face of said knife is further from said axis of rotation of said rotary cutter head than said cutting edge.

3. The apparatus as recited in claim **1** or **2** wherein said cutting edge angle is about 80° or more.

4. The apparatus as recited in claim **1** or **2** wherein said knife angle is about 0° to about −5°.

5. The apparatus as recited in claim **2** wherein a distance between said cutting edge and said bed knife is about 0.025 mm to about 0.25 mm.

6. The apparatus as recited in claim **1** or **2** wherein a helical angle between said axis of rotation and said cutting edge is about 0° to about 3°.

7. The apparatus as recited in claim **2** wherein said polymer is a solid.

8. A process for cutting polymer with a rotary cutter, wherein the improvement comprises, using a rotary cutter head which has an axis of rotation and one or more knives, each knife having a cutting edge on a circumferential periphery of said rotary head, each knife having a knife angle of about +10° to about −15°, and a cutting edge angle of 70° or more, and provided that no point on a cutting face of said knife is further from said axis of rotation of said rotary head than said cutting edge.

9. The process as recited in claim **8** wherein said cutting edge angle is about 80° or more.

10. The process as recited in claim **8** wherein said knife angle is about 0° to about −5°.

11. The process as recited in claim **8** wherein a distance between said cutting edge and a bed knife is about 0.025 mm to about 0.25 mm.

12. The process as recited in claim **8** wherein a helical angle between said axis of rotation and said cutting edge is about 0° to about 3°.

13. The process as recited in claim **8** wherein said polymer is a thermoplastic.

14. The process as recited in claim **13** wherein said polymer is originally in the form of a strand.

15. The process as recited in claim **13** wherein said polymer is continuously fed to said rotary cutter head.

16. The process as recited in claim **14** wherein a minimum cross sectional dimension of said strand is about 2 mm.

17. The process as recited in claim **14** wherein said strand has a circular or square cross section.

18. The process as recited in claim **8** or **14** wherein said polymer contains at least one filler or reinforcing agent.

19. The process as recited in claim **8** wherein pellets or granules of said polymer are produced.

20. The process as recited in claim **8** wherein said polymer being cut is solid.

* * * * *

US005163490A

United States Patent [19]

Meis

[11] Patent Number: 5,163,490

[45] Date f Patent: Nov. 17, 1992

[54] KNIFE CLAMP FOR WOOD PLANING HEADS

[75] Inventor: Thomas F. Meis, Eleva, Wis.

[73] Assignee: Jackson Lumber Harvester Company, Inc., Mondovi, Wis.

[21] Appl. No.: 785,308

[22] Filed: Oct. 30, 1991

[51] Int. Cl.^{5} B26D 1/12; B27G 13/04

[52] U.S. Cl. .... 144/230; 144/117 R; 144/162 R; 407/41; 407/46; 407/49

[58] Field of Search .... 407/5, 6, 31, 40, 41, 407/46, 48, 49, 50, 101; 144/117 R, 162 R, 172, 174, 218, 230, 241

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Primary Examiner—W. Donald Bray
Attorney, Agent, or Firm—Fuller, Ryan, Hohenfeldt & Kees

[57] ABSTRACT

A rotatable wood planing apparatus that includes a cylindrical planing knife body provided with a plurality of longitudinally extending, forwardly inclined, radially outwardly opening channels for holding knives. Parallel to each of the knife holding channels is an adjoining channel for holding a clamping means such as a gib for clamping said knives in the channels. The rear surfaces of the knife-holding channels and the forward surfaces of the knife-clamping channels are in planes that converge outwardly. A knife-holding clamp is provided to securely hold the knife in a desired position. The knives can accurately be fitted and secured into the clamps prior to insertion into the knife-holding channels.

Means such as bolts or screws adjacent the rear of the knife-holding channels are provided for retaining the clamp and knife combination in the channel. A gib or wedge is fitted in the clamping channel to lock the clamps and knives in place upon elevation of the gib in its channel. The gib has an angled surface for engaging the knife clamp and urging it, as the gib is raised, toward the rearward surface of the channel. The knife-holding channel has a width sufficiently greater than that of the clamp to permit pivoting of the clamp away from the retaining means for removal of the clamp-knife combination from the channel when the gib is lowered.

11 Claims, 1 Drawing Sheet

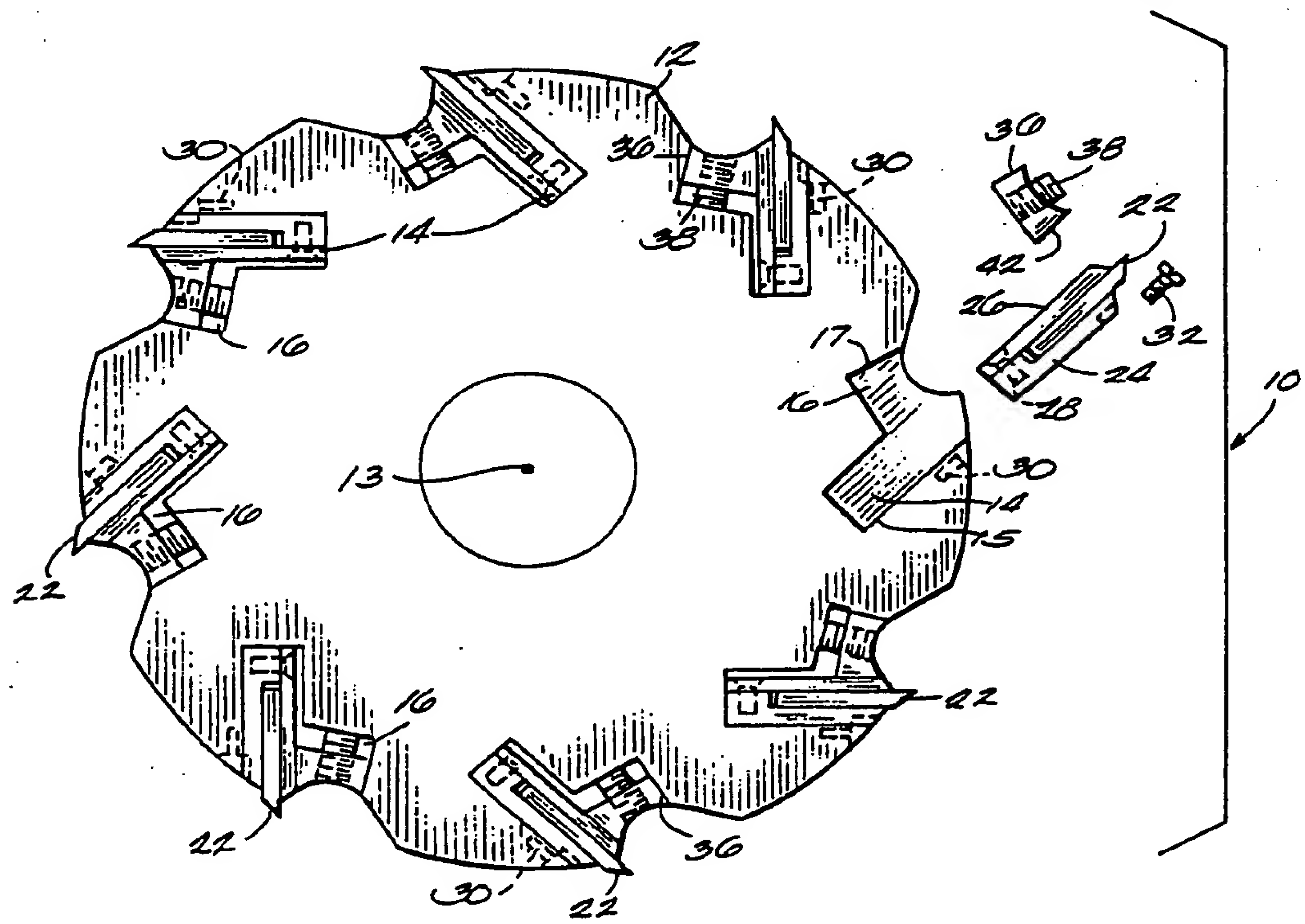
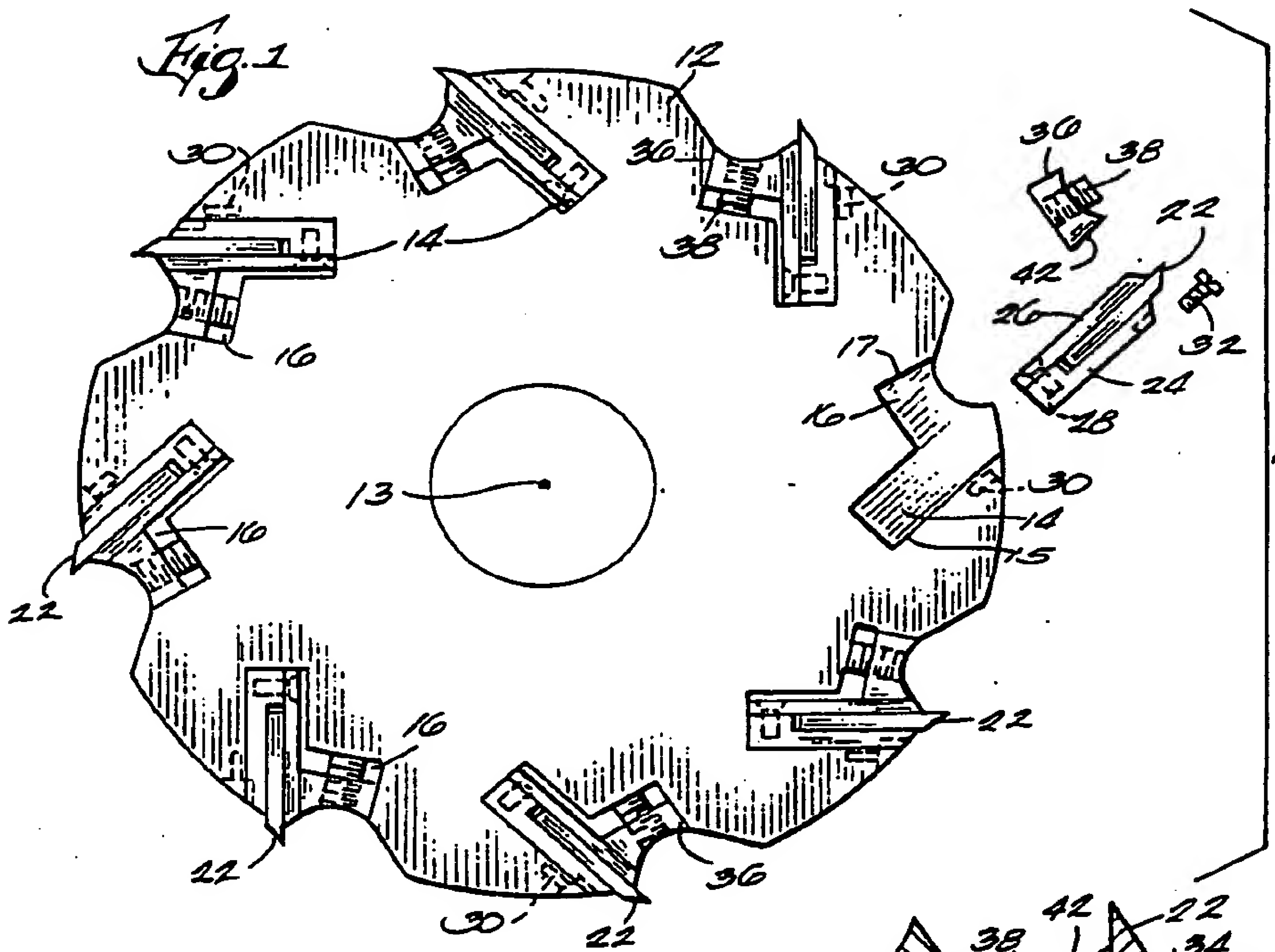


Fig. 1



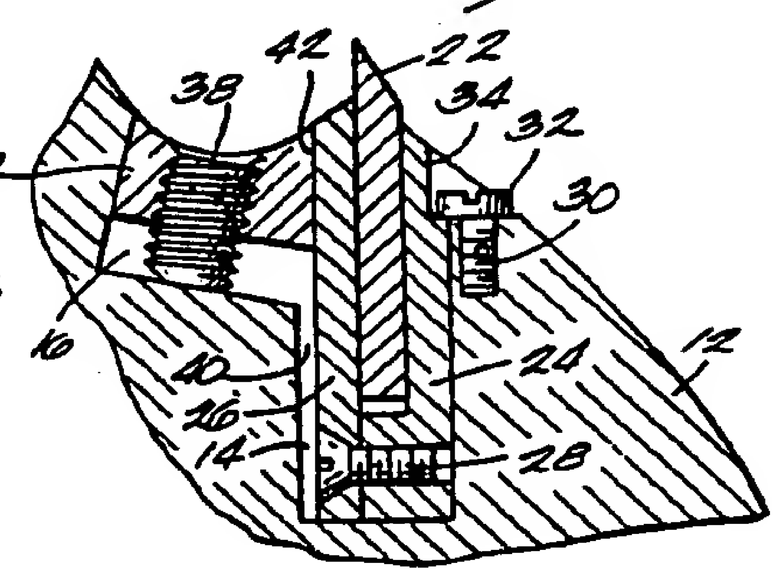


Fig. 3

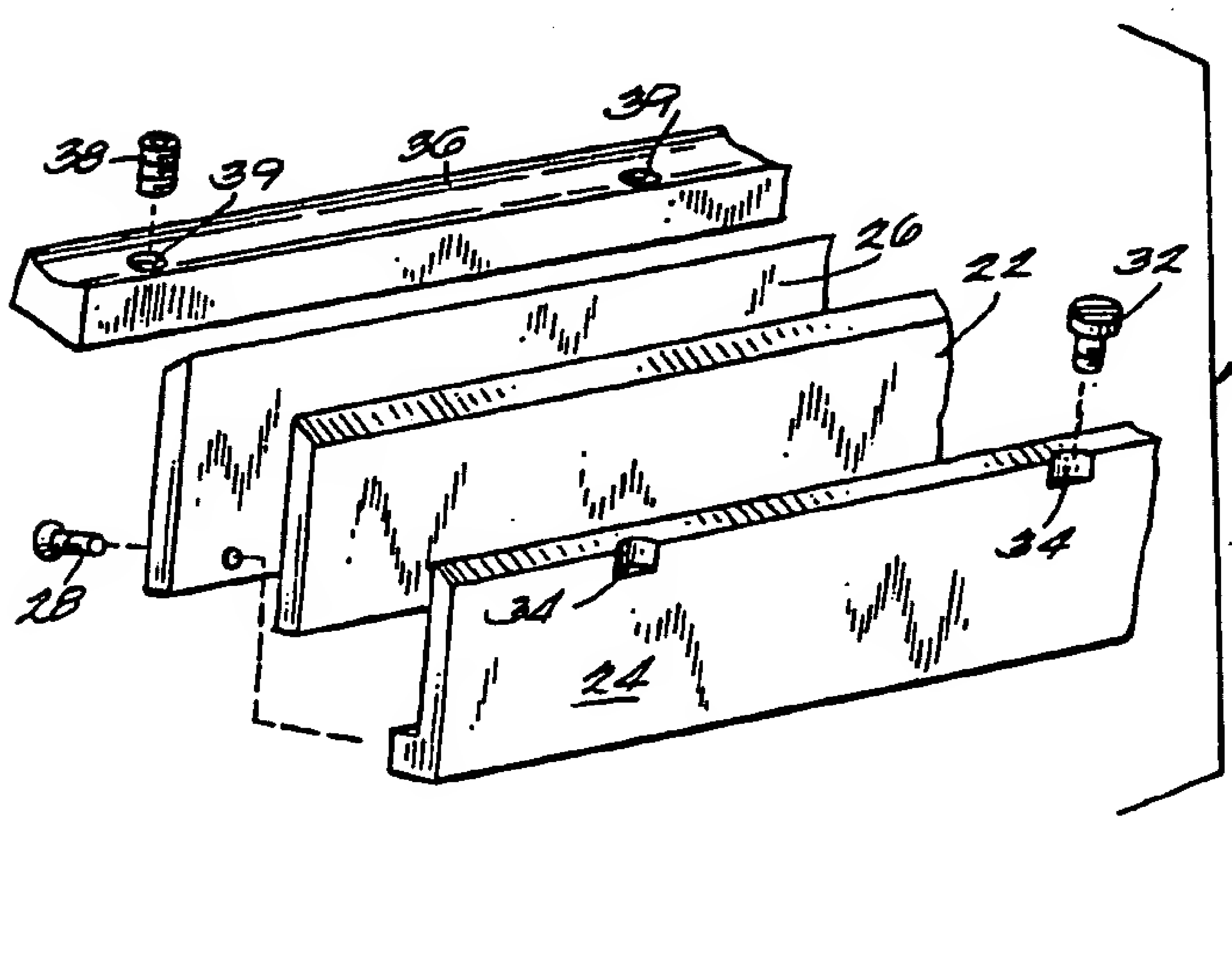


Fig. 2

KNIFE CLAMP FOR WOOD PLANING HEADS

FIELD OF THE INVENTION

The invention relates to wood planing heads. More particularly, the invention relates to the system for clamping and securing knives in a planing head such as a rotatable wood shaving metal head.

Various holders have heretofore been devised for holding and securing knives in wood planing devices such as rotatable cylindrical planing mill devices. Typically, the knife and any holder therefore are wedged in place by means of a wedge or gib. See, for example, U.S. Pat. No. 4,658,875 issued to Grabovac on Apr. 21, 1987. In such arrangements it has generally been necessary to clamp the knife in position with a wedge using an open end wrench. Generally, the knife was set at one depth dependent on the dimensions of the knife and knife holder. Other types of holders are shown in U.S. Pat. No. 1,315,536 issued Sep. 9, 1919 and U.S. Pat. No. 4,194,545 issued Mar. 25, 1980.

A shortcoming of knife holding systems currently in use relates to the fact that in order to adjust the depth of cut or amount of knife edge exposed or extending from the cutter head, the adjustment must be done on the cutter head itself. Since a cutter head may have eight or more knives, this necessitates shutting down of the entire mill for a time sufficient to allow the necessary adjustments to be performed. Such down time is a factor in the overall cost of the planing operation being performed.

BRIEF SUMMARY OF THE INVENTION

An important object of the present invention is to provide a knife clamping and securement system which permits accurate location of the knives on a fixture, jig or workbench located away from the planing device. An important advantage and aspect of the present invention is related to the fact that the knives can be changed quickly in the machine thus saving valuable production time. A related aspect is that the present invention enables the knives to be set more accurately and uniformly because the setting of the knives in the clamps can be performed where the components are readily accessible and where special tools or jigs enabling rapid and precise location of the knives is made possible.

A further aspect of the invention is the provision of a system in which the knife clamp is tightened into its cutting position in the head while raising a gib or wedge and yet maintaining the knife-holder combination in a desired position without fear that the rising gib will force the knife outwardly too high in the channel.

Briefly summarized, the invention provides a rotatable wood planing apparatus that includes a cylindrical planing knife body. The cylindrical body is provided with a plurality of longitudinally extending, forwardly inclined, radially outwardly opening channels for holding knives around the circumference of the rotatable body. Parallel to each of the knife holding channels is a longitudinally extending adjoining channel for holding a clamping means such as a gib for clamping said knives in the channels. The rear surfaces of the knife-holding channels and the forward surfaces of the knife-clamping channels are in planes that converge outwardly. A knife-holding clamp is provided to securely hold the knife in a desired position. The knives can accurately be fitted and secured into the clamps prior to insertion into the knife-holding channels. The knife-holding clamps include plates adapted to engage the opposite sides of the knife to hold the knife therebetween and means such as a machine screw to attach the plates to each other.

Means such as bolts or screws tapped in the planing knife holding body adjacent the rear of the knife-holding channels are provided for retaining the clamp and knife combination in the channel. A gib or wedge is fitted in the clamping channel to lock the clamps and knives in place. Means such as set screws are used to provide for adjustable elevation of the gib in its channel. The gib has an angled surface for engaging the knife clamp and urging it, as the gib is raised, toward the rearward surface of the channel. The knife-holding channel has a width sufficiently greater than that of the clamp to permit pivoting of the clamp away from the retaining means for removal of the clamp-knife combination from the channel when the gib is lowered.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be further set forth in the following detailed description and accompanying drawings wherein:

FIG. 1 is an end view of a cylindrical planing head showing the knife clamp and fastener system of the present invention with one set of knives, clamps and fasteners removed;

FIG. 2 is a perspective broken away view showing the knife, clamp, and securing gib in greater detail; and

FIG. 3 is a cross-sectional end view of a portion of a planer head, knife channel and knife securing channel.

Referring more particularly to the drawings there is seen a rotatable planing mill head 12 rotatable about an axis 13. A plurality of knife holding channels 14 are located around the perimeter of head 12. Adjoining each of the knife holding channels 14 is a shallower channel 16 adapted to hold a clamping means. Numeral 10 indicates the overall combination of the planer head and knives, clamps and clamping means.

Referring to FIG. 2, numeral 20 indicates the subcombination of a knife 20 and knife clamp formed of components 24 and 26 which are secured together by means of a screw 28 to hold the knife plate 22 therebetween. Preferably the means used to attach together the plates 24 and 26 is a countersunk screw fitted into a countersunk hole in one of said plates and threaded into a tapped hole in the other of the plates.

Channels 14 and 16 extend longitudinally along the length of cylindrical planing knife body 12. It will be noted that the rear surface 15 of channel 14 and the forward surface 17 of channel 16 are located in planes which converge in a radially outward direction with respect to planer head 12.

Knives 22 can be accurately placed between the clamp halves 24 and 26 and screw 28 tightened to secure the knife in the desired position. While clamp components 24 and 26 are shown with one L-shaped component and one straight component, other variations can be substituted, for example, both sides could be L-shaped.

Threaded holes 30 are tapped into the planer head 12 immediately adjacent the rear wall 15 of each of the knife holding channels 14. Retaining screws 32 are screwed into these tapped holes. Screws 32 remain in place even when the knife and clamp combinations are removed from the head or replacement or resetting. Notches 34 are provided in a part of the knife clamp

adjoining rear wall 15 in order to provide means coacting with screws 32 to hold the knife-clamp combination in place in the planing head and to prevent the same from arising therein.

A gib or wedge 36 is provided as a means to lock the knife-clamp combination in the planing head 12. Set screws 38 are provided to permit raising and lowering of gib 36 in channel 16. When gib 36 is lowered within channel 16, the knife and clamp combination can be pivoted away from screw 32 and simply lifted out of channel 14. This is due to the fact that channel 14 is wider than the thickness of the knives and clamps leaving a space 40 which allows pivoting of the clamp toward the gib and away from screw 32 for removal.

It will be noted that when the gib is raised by turning set screw 38, the fact that surfaces 15 and 17 converge enables the sloping surface 42 of the gib to urge the knife clamps 24, 26 to the right as viewed in FIG. 3 thus securely locking the clamp-knife combination in place.

It will be noted that in the case of a rotary planing device the longitudinal channels preferably are spaced around the perimeter of planer head at equally spaced intervals. Also, the forward wall of the gib-holding channel 16 in a plane perpendicular to that of the bottom of that channel, and the forward edge of the gib 36 is perpendicular to the bottom thereof. Note also that the cross-section of gib 36 is trapezoidal in shape with the rearward side being angled forwardly.

What is claimed is:

1. Rotatable wood planing apparatus comprising:

a cylindrical planing knife body having at least one longitudinal outwardly opening channel for holding a knife, said channel being forwardly inclined int he cutting direction,

a parallel longitudinally extending channel adjoining said knife-holding channel for holding a means for clamping said knife in said channel, the rear surface of said knife-holding channel and the forward surfaces of said knife-clamping channels being in planes that converge outwardly,

a knife held in a knife-holding clamp and fitted longitudinally in said knife-holding channel,

said knife-holding clamp comprising plates engaging the opposite sides of said knife to hold said knife therebetween and means to attach said plates to each other,

means on said planing knife holding body adjacent the rear of said channel for retaining said clamp and knife in said channel,

a gib fitting in said clamping channel and provided with means to adjustably elevate said gib toward the outside of said channel said give having a surface for engaging said knife clamp and urging it toward the rearward surface of said channel, as said gib is raised, another surface of the gib engaging a converging surface of said channel to secure the gib, clamp and knife therein when said gib is raised,

said knife-holding channel having a width sufficiently greater than that of said clamp to permit pivoting of said clamp away from said retaining means for removal of said clamp and knife from said channel when said gib is lowered.

2. Apparatus according to claim 1 wherein the forward wall of the gib holding channel is in a plane perpendicular to that of the bottom of said channel, and the forward edge of said gib is perpendicular to the bottom thereof.

3. Apparatus according to claim 2 wherein the cross-section of said gib is trapezoidal in shape with the rearward side thereof being angled forwardly.

4. Apparatus according to claim 1 wherein said clamp comprises a first flat plate and a second L-shaped plate, said means to attache said plates together comprising a countersunk screw fitted into a countersunk hole in one of said plates and threaded into a tapped hole in the other of said plates.

5. Apparatus according to claim 1 wherein said retaining means comprises a bolt threaded into a tapped hole in said body adjacent to said knife-holding channel.

6. Rotatable wood planing apparatus comprising:

a cylindrical planing knife body having a plurality of longitudinally extending, forwardly inclined, radially outwardly opening channels for holding knives, and parallel longitudinally extending channels adjoining each of said knife-holding channels for holding a means for clamping said knives in said channels, the rear surfaces of said knife-holding channels and the forward surfaces of said knife-clamping channels being in planes that converge outwardly,

a knife adapted to be held in a knife-holding clamp and fitted longitudinally in said knife-holding channel,

said knife-holding clamp comprising plates adapted to engage the opposite sides of said knife to hold said knife therebetween and means to attache said plates to each other,

means on said planing knife holding body adjacent the rear of said channel for retaining said clamp and knife in said channel,

a gib fitting in said clamping channel provided with means to adjustably elevate said gib toward the outside of said cylindrical body, said gib having a surface for engaging said knife clamp and urging it, as said gib is raised, toward the rearward surface of said channel, another surface of the gib engaging a converging surface of said channel to secure the gib, clamp and knife therein when said gib is raised,

said knife-holding channel having a width sufficiently greater than that of said clamp to permit pivoting of said clamp away from said retaining means for removal of said clamp and knife from said channel when said gib is lowered.

7. Apparatus according to claim 6 wherein said longitudinal channels are spaced around the perimeter of said body at equally spaced intervals.

8. Apparatus according to claim 6 wherein the forward wall of the gib holding channel is in a plane perpendicular to that of the bottom of said channel, and the forward edge of said gib is perpendicular to the bottom thereof.

9. Apparatus according to claim 8 wherein the cross-section of said gib is trapezoidal in shape with the rearward side thereof being angled forwardly.

10. Apparatus according to claim 6 wherein said clamp comprises a first flat plate and a second L-shaped plate, said means to attache said plates together comprising a countersunk screw fitted into a countersunk hole in one of said plates and threaded into a tapped hole in the other of said plates.

11. Apparatus according to claim 6 wherein said retaining means comprises a bolt threaded into a tapped hole in said body adjacent to said knife-holding channel.

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